

WHAT IS CLAIMED IS:

1. A method of fabricating a semiconductor device, comprising the steps of:
5 forming a lower electrode on a substrate;
subjecting the lower electrode to a pre-annealing, wherein the pre-annealing is a
thermal annealing under a selected atmosphere;
forming a capacitor dielectric layer on the lower electrode; and
forming an upper electrode on the capacitor dielectric layer.
- 10 2. The method of claim 1, wherein the lower electrode is formed of a metal.
3. The method of claim 1, wherein the lower electrode is formed by a CVD method.
4. The method of claim 3, wherein a metal organic material is used as a source of the
CVD method
-
5. The method of claim 1, wherein the capacitor dielectric layer is formed of a
crystalline material.
-
- 20 6. The method of claim 1, wherein the pre-annealing does not substantially change the
materiality of the lower electrode.
7. The method of claim 1, which further comprises subjecting the capacitor dielectric
25 layer to a crystallization annealing, and wherein a processing temperature of the pre-
annealing is higher than that of the crystallization annealing.
8. The method of claim 1, wherein the pre-annealing is performed at a range of between
about 350 ~ 750 °C.
- 30 9. The method of claim 1, wherein the selected atmosphere comprises a hydrogen gas.
10. The method of claim 1, wherein the selected atmosphere comprises a nitrogen gas.

Sub 13/10
11. The method of claim 1, wherein the selected atmosphere is a mixed atmosphere.

Sub 13/10
12. The method of claim 11, wherein the mixed atmosphere comprise a hydrogen and a nitrogen gas.

Sub 13/10
13. A method of fabricating a semiconductor device, comprising the steps of:
forming a lower electrode on a substrate;
subjecting the lower electrode to a pre-annealing, wherein the pre-annealing is a treatment exposing the lower electrode under a plasma atmosphere;
forming a capacitor dielectric layer on the lower electrode; and
forming an upper electrode on the capacitor dielectric layer.

14. The method of claim 13, wherein the lower electrode is formed of a metal, and the metal is formed by a CVD method.

15. The method of claim 14, wherein a metal organic material is used as a source of the CVD method

16. The method of claim 13, wherein the capacitor dielectric layer is formed of a crystalline material.

17. The method of claim 13, wherein the pre-annealing does not substantially change the materiality of the lower electrode.

18. The method of claim 13, which further comprises subjecting the capacitor dielectric layer to a crystallization annealing, and wherein a processing temperature of the pre-annealing is higher than that of the crystallization annealing.

19. The method of claim 13, wherein the plasma atmosphere comprises a hydrogen gas.

20. A method of fabricating a semiconductor device, comprising the steps of:
forming a metal lower electrode on a substrate, wherein the metal lower electrode is formed by a CVD method;

subjecting the metal lower electrode to a pre-annealing;
forming a capacitor dielectric layer on the metal lower electrode; and
forming an upper electrode on the capacitor dielectric layer.

SUB
1.5
CMD.

5 21. The method of claim 20, wherein the pre-annealing is one selected from the group consisting of a thermal annealing under a selected atmosphere and a treatment exposing the metal lower electrode under a plasma atmosphere.

10 22. The method of claim 21, wherein the capacitor dielectric layer is formed of a crystalline material.

23. The method of claim 21, wherein the pre-annealing does not substantially change the materiality of the metal lower electrode.

24. The method of claim 21, which further comprises subjecting the capacitor dielectric layer to a crystallization annealing, and wherein a processing temperature of thermal annealing is higher than that of the crystallization annealing.

25. The method of claim 24, wherein the processing temperature of crystallization annealing is about 650°C.

26. The method of claim 21, wherein the selected atmosphere comprises a hydrogen gas and the thermal annealing is performed at about 450°C.

25 27. The method of claim 21, wherein the selected atmosphere comprises a nitrogen gas and the thermal annealing is performed at about 700°C.

28. The method of claim 21, wherein the selected atmosphere is a mixed atmosphere including about 90% of nitrogen and about 10% of hydrogen by volume.

30

29. The method of claim 28, wherein the thermal annealing is performed at about 450°C.

100
2-7